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Marketing Research Report No. 94

Methods of Increasing Productivity in Modern Grocery Warehouses

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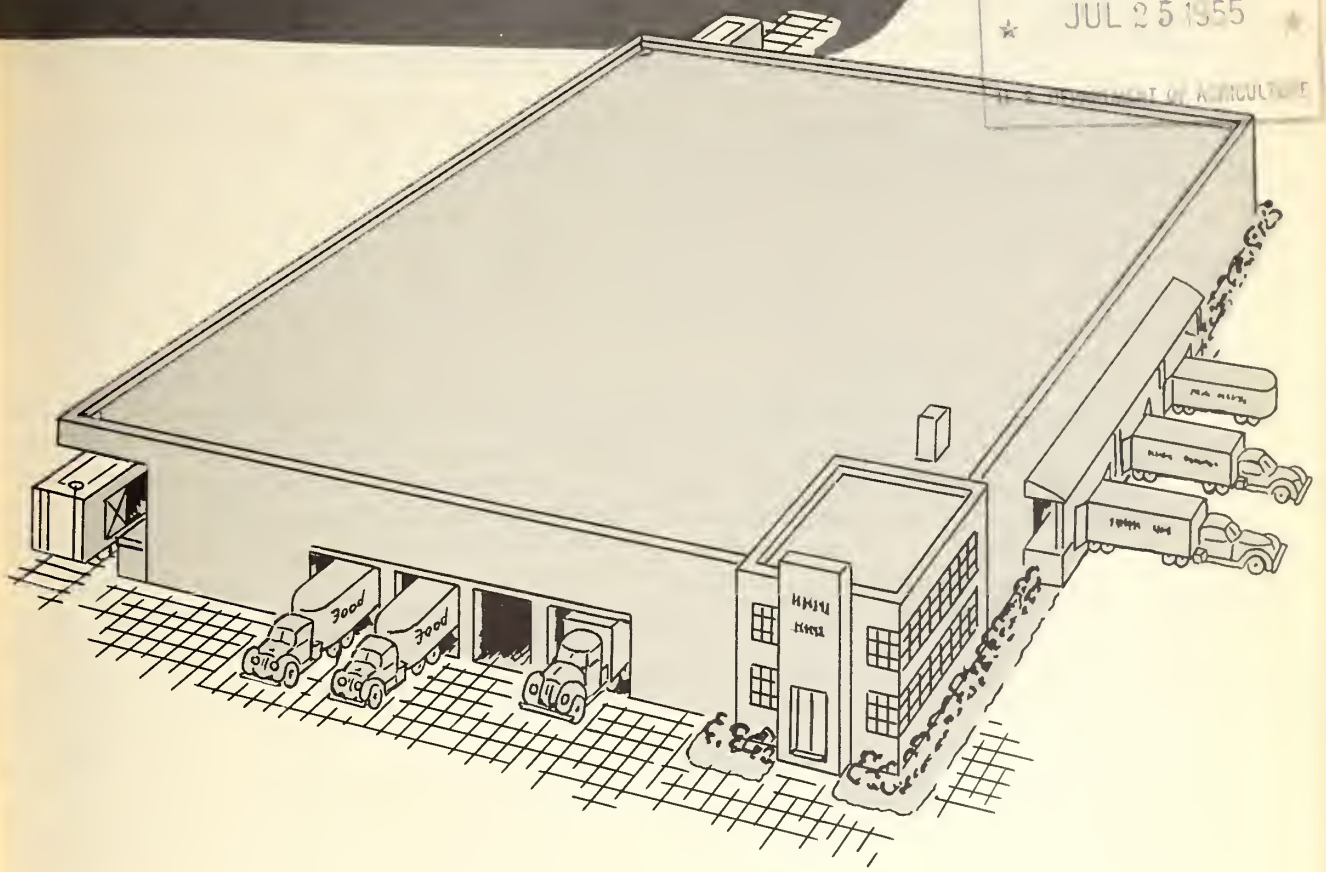

U. S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
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PREFACE

This report is based on research undertaken to aid grocery wholesalers in reducing their warehouse labor costs through improved work methods and equipment. The work was conducted under the general supervision of R. W. Hoecker, Head, Wholesaling and Retailing Section, Transportation and Facilities Branch, Marketing Research Division, Agricultural Marketing Service. The study was made under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

Acknowledgment is made to Ralph B. Johnson, executive vice president, and Rudolph L. Treuenfels, marketing counsel, National-American Wholesale Grocers' Association, for their assistance in the planning and guidance of the study as well as their cooperation in working with the trade. Special credit is due the following wholesale grocery companies that made their plants available for detailed study: A. W. Cullum Co., Inc., Dallas, Tex.; Flagstaff Foods, Perth Amboy, N. J.; Frey and Son, Inc., Baltimore, Md.; Hannaford Brothers Co., Portland, Maine; Layton and Co., Inc., Dover, Del.; and Super Valu Stores, Inc., Minneapolis, Minn. In addition, a number of other chain store and independent grocery warehouse operators were helpful in furnishing records and facilities for study.

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SUMMARY

The number of man-hours required in the warehousing operation was reduced an average of 13 percent in 6 modern one-floor wholesale grocery warehouses studied,through improved work methods, better utilization of equipment, and balanced work crews. Projected man-hour savings of an additional 8 percent, for a total saving of 21 percent, can be expected after new equipment is installed and in operation. Since labor accounts for more than 50 percent of the warehousing cost, methods of increasing productivity are of major concern to warehouse management.

The primary objective of this study was to evaluate present methods of grocery warehousing and to study methods of increasing the productivity of warehousemen in the receiving, order selecting, checking and loading operations. These operations were observed in 63 grocery warehouses in various sections of the country; and in 6 of the firms, operating in modern one-floor warehouses, these operations were studied intensively.

Increased labor productivity was achieved in receiving groceries by separating the palletizing operation from the storing operation. In 3 of the firms studied intensively, the palletizing crew spent an average of 62 percent of their time waiting for the forklift truck. In 2 of these firms, the total number of men palletizing merchandise was reduced 33 percent, from 6 to 4, and productivity of the forklift storing operation increased by separating the palletizing and storing operations.

Productivity of one man working alone in palletizing groceries and moving the loaded pallet out of the car was nearly 38 percent greater per man-hour than for a 2-man team. Economies can be gained by using one man to unload cars provided the car can remain at the dock long enough for one man to unload it and provided one man is not required to unload such heavy merchandise as green coffee and bulk flour and sugar.

The materials-handling equipment for order assembly in the modern warehouse includes the 4-wheel warehouse truck pushed by hand, the tow line, small gasoline and electric tractors, remote-controlled order-filler tractors, and conveyor lines. The effective use of the 4-wheel, hand-pushed warehouse truck requires the use of a short selection line in order to keep order filler travel time to a minimum. With a small gasoline or electric tractor towing 4-wheel warehouse trucks, travel time was reduced 42 percent over hand pushing when order fillers traveled 1,500 feet in the assembly of a 30-case order. An additional reduction of more than 20 percent in travel time was accomplished when remote-controlled units were used with a small electric tractor. Perimeter tow lines were used effectively in large warehouses to move assembled orders to the shipping dock, and they reduced travel time of order fillers and the confusion caused by order fillers continually bringing assembled orders to the shipping dock.

In addition to materials-handling equipment, stock arrangement and order size have a direct influence on the productivity of order fillers. Order filler productivity with the slot system and tow tractors averaged

48 cases per hour on orders of 1 to 10 cases, while they averaged 159 cases per hour on orders of 75 to 100 cases. The productivity was much greater with the short selection line and conveyor system than with the slot system and tow tractors, especially in the assembly of small orders. On orders of 1 to 10 cases, order filler production averaged more than twice as much, or 127 cases per hour, with the short assembly conveyor system as it did with the slot system and tow tractors.

Many delay factors have an influence on order-filler productivity. The man-hour cost of these factors becomes significant when these delays are timed and multiplied by the frequency of occurrence. Common causes of excessive order-filler delay are: (1) Time lost in hunting for a particular item; (2) waiting for forklifts to lower inaccessible merchandise or bring merchandise from reserve storage; (3) waiting because of aisle blockage; (4) waiting for orders to be processed; (5) waiting for selector trucks; (6) waiting for a work assignment; and (7) time lost in correcting order-filler errors. Order-filler productivity can be increased by determining the causes of delays and correcting them.

The productivity of a 2-man team in checking orders by item description and case count was increased almost 38 percent when the first half of the items on the invoice were placed on one side of the 4-wheel selector truck and the other half were placed on the other side by order selectors. One man checking orders averaged 1,208 cases per hour, or nearly 75 percent more than each man in a 2-man team. Added economies can be gained in checking orders through: (1) Eliminating duplicated order checks, and (2) sample checking.

Merchandise was unit price marked 37 percent faster by order fillers during order assembly than after assembly. Both the order filler and order checker unit price marked cases at approximately the same rate after order assembly. Two checkers working as a team averaged only about two-thirds as many cases per man-hour as one man working alone.

In loading delivery trucks, 1 man handled approximately a third more cases per man-hour than 2 men working as a team. When merchandise was placed on conveyors during order selection in the warehouse, greater productivity of truck loaders was obtained when the conveyor was extended into the delivery truck. This method eliminated pushing 4-wheel trucks into and out of the delivery truck.

Two methods of separating retailer orders on delivery trucks were observed during the study. One method was to divide each order on the truck with cotton cord netting of approximately 2-inch mesh. Another was to mark each case with the stop number; for example, 2, 3, 4, etc., leaving the first and last stops unnumbered. The use of netting is advantageous when orders are large enough to facilitate proper separation on the truck.

In addition to work methods and equipment, other factors that help to increase the efficiency and productivity of the warehousing operation are: (1) Increased retailer cooperation; (2) good employee motivation; and (3) use of cost control programs.

METHODS OF INCREASING PRODUCTIVITY IN MODERN GROCERY WAREHOUSES

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INTRODUCTION

During the last two decades, many changes have occurred in the field of retail food distribution as evidenced by the modern food supermarket and superette. Although not apparent to everyone, significant improvements have also been made in the warehousing operation. These changes and improvements are reflected in lower operating margins in both the modern food store and wholesale operations. In addition to operating on a lower markup, the wholesale grocer today offers many more services to his retailer customers. 1/

The wholesale grocery business is commonly divided into the following major functions: (1) Administrative, (2) selling, (3) warehousing, and (4) delivery. This study deals only with the warehousing function, which accounts for approximately a fourth of the wholesaler's operating cost. 2/ More than half of the warehousing cost is made up of labor cost; however, many changes have been made in warehouse design and methods of operation in an attempt to reduce the amount of labor required. A preliminary survey of modern grocery warehouses indicated that there were a number of opportunities for increasing labor efficiency in receiving, assembling, and shipping groceries through improved handling methods, work organization, and equipment. This study was directed toward the reduction of cost in these areas of grocery warehousing.

In planning this study, the following objectives were given primary consideration: (1) To evaluate present methods of warehousing used by wholesale grocers; and (2) to study methods of increasing the productivity of warehousemen in receiving, order selecting, checking, and loading groceries.

The grocery-receiving, order-assembly, and truck-loading operations were observed in 63 grocery warehouses located in various sections of the country. Many references in this report are based on observations in these warehouses. Most of the study, however, relates to 6 of these firms, operating in modern one-floor warehouses whose operations were studied intensively. Industrial engineering techniques, such as time studies and ratio-delay studies, were used in obtaining data on the various segments of the warehouse operations of these 6 firms. The 6 warehouses were located along the East Coast, in the Midwest, and the Far South regions of the

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1/ Davenport, John H., and Hoecker, R. W. How Some Wholesale Grocers Build Better Retailers. MRR No. 12 PMA, U. S. Dept. Agri. 1952.

2/ Ibid., p. 4.

United States. These firms sponsored voluntary groups of retail grocers and had annual business volumes in dry groceries ranging from $4,000,000 to $20,000,000 in the warehouses studied.

GROCERY RECEIVING OPERATION

The grocery warehouse receiving operation usually begins when merchandise is spotted at the receiving platform by the common carrier. The operation includes palletizing, moving merchandise to the storage point, stacking, and placing it in the order assembly line for selection by order fillers. Approximately 31 percent of the warehouse man-hours in the 6 firms studied intensively were spent in the receiving operation.

Grocery shipments to the warehouses studied were almost equally divided between rail and motortruck, although the proportion of receipts by motortruck has been increasing substantially during the last two decades. Wholesale grocers stated that advantages of receiving merchandise by motortruck included: (1) Truck drivers usually palletize merchandise in the truck while unloading, thus eliminating the need for the firm to bear this cost; and (2) claims for damaged merchandise are more easily adjusted. Merchandise damaged during transit in motortrucks is usually sent back to the shipper on the same truck on which it arrived. Merchandise damaged in rail transit usually is piled in the warehouse for inspection before claim adjustment is made, thus taking up valuable warehouse space and contributing to aisle congestion.

The modern one-floor warehouse has several advantages over the multistory warehouse for efficient receiving of merchandise. Fewer man-hours are required to move merchandise horizontally to the storage point than horizontally and vertically as must be done in the multistory operation. The one-floor warehouse also has more dock space for receiving merchandise from common carriers. This results in less congestion around the dock and a more flexible workload schedule.

With unit (pallet) load handling, the tons of merchandise handled per man-hour in receiving groceries are more than twice as great as in the shipping operation; nevertheless, receipts must still be unloaded case by case in the rail car or motortruck onto a pallet, conveyor, or handtruck (4-wheeler). For wholesale grocers, the initial cost of case-by-case handling is unavoidable except when merchandise is received by motortruck and the driver places it on the pallets.

Methods of Receiving Groceries

The predominate method of receiving groceries in modern warehouses is first to palletize all merchandise in the railroad car or motortruck. The companies cooperating in the study used the following 2 pallet sizes, each with 40-inch stringers: (1) A 40- by 48-inch pallet for bulky fast-moving merchandise such as soap powder, dry breakfast cereals, and paper goods; and (2) a 40- by 32-inch pallet for handling most of the other grocery items.

From the point of palletization to storage, the merchandise was handled as a unit (pallet) load. When pallets were used they were removed from the car or motortruck with hand-operated low-lift pallet jacks, electrically operated pallet jacks, or forklift trucks; or with live or semilive skids or handtrucks (4-wheelers) from which pallet loads were removed later with forklift trucks. The loaded pallets were then either left in the aisle for subsequent movement to storage by the forklift or moved direct to storage.

In unloading refrigerated cars, conveyors were frequently used in conjunction with the palletizing operation because pallet jacks, 4-wheel handtrucks, and forklift trucks would not roll readily over the car floors. When conveyors are used, almost twice as many man-hours are required in the palletizing operation because each case of merchandise must be handled twice: (1) When it is placed on the conveyor; and (2) when it is removed from the conveyor and placed on a pallet.

In warehouses having a complete conveyor system, a portable extension is put in the car or motortruck and the same conveyor line is used for both receiving and shipping merchandise. With the conveyor system, it is necessary to man the conveyor at the point of unloading and at the stacking point. The conveyor supplies transportation only; it does not necessarily eliminate any of the case handling.

Handtrucks are seldom used exclusively to receive merchandise in the modern warehouse today. With this method, merchandise is loaded case by case onto the handtruck, then moved to a storage point in the warehouse and unloaded case by case. The inefficiency of this system results not only from case-by-case handling but also from the frequent trips to storage with small loads, a greater amount of unloading time, and greater worker fatigue when compared with mechanical systems.

Improved Methods of Receiving Merchandise

Improvements in the productivity and efficiency of receiving merchandise were possible even in modern warehouses with excellent receiving facilities. Three warehouses in which this study was conducted used a crew of 2 men to palletize merchandise in the car. The loaded pallet was then moved directly to storage by a forklift. Time studies of this operation showed that the crew palletizing the merchandise spent an average of 62 percent of their time waiting for the forklift to move the pallet of merchandise to storage. When the palletizing crew was divorced from the forklift storing operation by supplying this crew with a pallet jack, a 4-wheel handtruck, or a skid to move palletized merchandise out of the car or motortruck onto the unloading dock for subsequent storing by the forklift, two major advantages were gained: (1) The system eliminated the waiting time by the palletizing crew for the forklift, or vice versa; and (2) it eliminated forklift delays caused by sharp turns in entering and leaving the car. In 2 of the firms in which the palletizing and storing operations were separated, the number of men palletizing merchandise was reduced from 6 to 4 and,

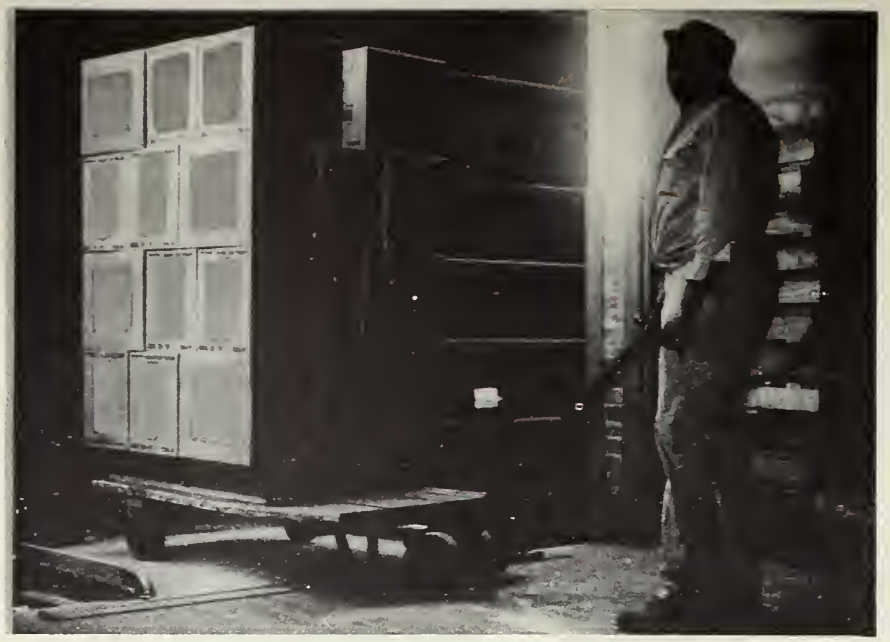

Figure 1.--Using an old semilive skid to move a pallet load of merchandise out of rail car.

in addition, productivity of the forklift storing operation increased. Old warehouse equipment was used in making this change. Figure 1 shows the use of an old semilive skid for moving a pallet load of merchandise out of a car in one of the firms cooperating in the study. A 4-wheel handtruck also could be used for this purpose.

Three important factors were noted that contributed to excessive forklift delay in storing merchandise:

1. Insufficient mast height on forklifts to reach the second pallet when storing merchandise 2 pallets high over pallet racks. The typical cycle in placing a pallet of new merchandise on top of one pallet in storage over a pallet rack consisted of (a) bringing the pallet load from the point of palletization to the storage area, (b) placing this pallet of new merchandise in the aisle, (c) positioning the forklift and obtaining the one pallet in storage and placing it on top of the pallet of new merchandise, and (d) positioning the forklift in the bottom pallet and lifting both pallets over the rack and into position. The time lost in this cycle totaled 2.77 minutes when compared with placing the pallet of new merchandise over the rack and one pallet of merchandise in storage when mast height was sufficient. A similar forklift delay occurred when merchandise was removed from storage and placed in the active selection line.

2. Interruptions by order fillers to let down inaccessible merchandise, or to bring merchandise from the reserve storage area. A study of these interruptions revealed an average of 3.05 minutes were required to make the let down and return to the storing operation.

3. Hunting for a place to store merchandise. Frequently the merchandise storage area had to be rearranged or shifted in order to accommodate the new merchandise.

The following methods were used to reduce these delays for the firms studied. The problem of insufficient mast height on forklift trucks was remedied in one firm when a new forklift was purchased by specifying the proper mast height to reach the second pallet in storage over pallet racks. An alternative method was to replace the old mast on an existing forklift truck with one of the proper height. Delays caused by order-filler interruptions were eliminated in one warehouse by assigning to a forklift driver the responsibility for letting down inaccessible merchandise, bringing merchandise from the reserve storage area in advance of order-filler needs, and answering order-filler calls. Order-filler production increased more than enough to pay for the driver and forklift time. Another method of handling the problem was to assign several forklifts to the selection area at the beginning of the day (and at other times when needed) to keep the selection line well stocked.

One Man Versus 2-Man Team in Unloading Rail Cars

The productivity of 1 man working alone in unloading cars was compared with that of a 2-man team. An electric, low-lift pallet jack was used for removing the loaded pallet out of the rail car, because one man could not readily pull a loaded pallet with a hand pallet jack. The summary of findings shown in table 1 is based on a 1,600-case car of No. 2 canned goods, weighing 60,800 pounds. An 8-case block with cases piled 5 high was used for palletizing.

Table 1.--Comparative time required for 1 man and a 2-man team to palletize and move loaded pallets out of a rail car

Element	One man	2-man team
	Man-minutes	Man-minutes
Obtain cases and place on pallet	142.40	172.80
Moving loaded pallet out of car	35.80	35.80
Bringing empty pallets into car	2.24	2.24
Delay for second man in car	0.00	1/ 38.04
Total	180.44	248.88
Fifteen percent personal and fatigue allowance	27.07	37.33
Total man-minutes	207.51	286.21
Elapsed time (hours)	3.46	2.38
Cases per hour	462	672
Cases per man-hour	462	336

1/ This delay could probably be reduced by having one man start palletizing merchandise on an empty pallet while the first man removed the loaded pallet and returned with an empty pallet.

As shown in table 1, 3.46 hours were required for 1 man to unload the car while 2 men unloaded the car in 2.38 hours. In this instance, the productivity of 1 man was almost 38 percent greater on the basis of production per man-hour (462 cases per man-hour compared with 336 cases per man-hour) than the productivity of a 2-man team. The difference in productivity under the 2 methods was caused by delay time in the following operations when a 2-man team was used: (1) Only 1 man was required to remove the loaded pallet and return with an empty pallet; and (2) in palletizing merchandise, the men got in each other's way because of the congested area. One man should not be expected to unload a car of such heavy items as green coffee or bulk 100-pound sacks of beans, sugar, or flour.

ORDER ASSEMBLY IN THE MODERN WAREHOUSE

Order assembly in the grocery warehouse involves grouping together all merchandise ordered by the customer from warehouse stocks. It includes picking up the invoice, selecting the merchandise from warehouse stocks, placing it on a 4-wheel handtruck, conveyor, or skid, and moving it to the shipping dock.

In the 6 warehouses studied intensively, nearly 40 percent of the warehouse man-hours were employed in this operation. The number of man-hours required for the assembly of grocery orders varies widely among wholesale grocery companies and is largely dependent on the type of materials-handling equipment used, the stock arrangement used, and the size of orders assembled.

In this study, it was found that no one combination of materials-handling equipment and stock arrangement can be used to achieve the smallest number of man-hours or lowest cost operation for all warehouses. Analysis made on the influence of each of the variables (materials-handling equipment, stock arrangement, and order size) on productivity of warehousemen is not complete because variable factors could not be held constant for the cooperating firms. An indication of the influence of each of the variables on the productivity of order fillers is given in subsequent sections.

Materials-Handling Equipment Used in Order Assembly

The 4-wheel handtruck is probably the simplest and most extensively used piece of materials-handling equipment in grocery warehouses today. The typical procedure for assembly of an order with the 4-wheel handtruck is for an order filler to push the truck through the warehouse and place the merchandise ordered on it. After the order is completely assembled, the order filler pushes the handtruck to the shipping dock. A 4-wheel handtruck has the following advantages: (1) Initial cost is low; (2) maintenance cost is low; (3) narrower aisles can be used in the warehouse when compared with requirements for power equipment; and (4) the truck can be used in receiving merchandise as well as order assembly. For order assembly purposes, a 4-wheel handtruck has the following disadvantages; (1) It requires a considerable amount of labor when compared with other equipment in the one-floor warehouse, because of the travel distance and limited amount of weight and bulk

it will accommodate; and (2) it requires careful planning of merchandise arrangement to keep travel distance and weight of haul to a minimum and to maximize the use of labor in order assembly. 3/

Time studies were made to compare the relative productivity of the 4-wheel handtruck with other order assembly equipment. As shown in table 2, the use of a 4-wheel handtruck requires nearly 42 percent more travel time (9.22 minutes compared with 5.37 minutes) than small gasoline or electric tractors in the assembly of a 30-case order requiring 1,500 feet of travel.

Table 2.--A comparison of time required to assemble a 30-case order requiring 1,500 feet of travel using various types of materials-handling equipment

Elements of order assembly	Materials-handling equipment		
	4-wheel handtrucks	Small gasoline or electric tow tractors	Remote-controlled tow tractors
	Man-minutes	Man-minutes	Man-minutes
Travel time	9.22	5.37	4.26
Selection time	3.24	3.24	3.24
Other productive time	1.09	1.09	1.09
Total time	13.55	9.70	8.59
Personal and fatigue allowance	2.03	1.46	1.29
Standard time	15.58	11.16	9.88
Cases per man-hour	116	161	182

The total time shown in table 2 to assemble a 30-case order is divided into travel time (including the time to obtain, hook, and unhook the 4-wheel warehouse trucks and to go from one selection point to the next), selection time (time to obtain case and place on warehouse truck), and other productive time required for such elements as obtaining an invoice and reading it. Firms in which time studies were made had stock locations numbered and orders printed in the same sequence as the stock locations.

Tow lines have been installed in many firms to overcome the disadvantage of the relatively small weight and bulk that can be handled by one man with a 4-wheel handtruck. The tow line follows the appointed round of the

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3/ For a discussion of warehouse layout with the use of a 4-wheel handtruck, see: Kriesberg, Martin. Methods of Handling and Delivering Orders Used by Some Leading Wholesale Grocers. MRR No. 13. PMA, U. S. Dept. Agr. 1952, pp. 18-20.

assembly area. It has the advantage of reducing manpower required to move assembled merchandise through the warehouse and to the shipping dock. The chief disadvantages of the tow line when used to tow 4-wheel trucks while orders are being assembled are: (1) It moves either too fast or too slow for many order fillers, and its speed is often geared to the slower workers; and (2) it is a rather permanent installation resulting in a comparatively inflexible assembly area layout.

The perimeter tow line is an adaption of the regular tow line which operates throughout the total assembly area. A perimeter tow line is used to move assembled orders on 4-wheel trucks to the shipping dock and to bring empty trucks to the assembly area. It does not follow the appointed round of the assembly area as does the tow line. Figure 2 shows an in-the-floor perimeter tow line used by one firm cooperating in this study. The advantages of both the perimeter tow line and regular tow line include: (1) They eliminate order-filler travel time to the shipping dock; (2) they reduce delay and confusion on the shipping dock due to order fillers continually bringing in assembled orders; and (3) under a properly managed system, they permit order fillers to remain in the order assembly area at all times. The perimeter tow line has the following advantages over a regular tow line: (1) Equipment cost is lower because the line is shorter; and (2) order-filler production is not geared to the speed of a perimeter tow line. Disadvantages in the use of a perimeter tow line as well as the regular tow line include: (1) Cost of the equipment; and (2) aisle space required for tow line operation.

Figure 2.--An in-the-floor towline built around the perimeter of the warehouse.

Small gasoline and electric tractors are used in many wholesale grocery warehouses to tow 4-wheel trucks during the order assembly process and to tow loaded 4-wheel trucks to the shipping dock. As shown in table 2, these machines have the advantage of reducing the amount of travel time for the order filler and are less fatiguing when compared with pushing 4-wheel trucks by hand. A typical cycle in assembling an order with a tow tractor includes: (1) Dismounting the tow tractor and walking to selection point; (2) picking up a case of merchandise, carrying it to the 4-wheel truck, and placing it on the truck; (3) walking up to and mounting the tow tractor; and (4) moving to the next selection point. The use of a train (two or more warehouse trucks coupled together) in the selection of large orders, although an advantage over single warehouse trucks, is not used extensively because the walk to and from the tow truck becomes progressively longer with the addition of each warehouse truck. Another factor to be considered with the use of a gasoline or electric tractor is the initial cost, as well as the operating and maintenance cost, of the equipment.

An electronic tow truck developed to operate by remote control and designed to eliminate the time required for walking to the tow tractor and returning to the stacks was tested. The tow tractor is started, stopped, and turned either right or left by a control device worn on the belt of the order filler. The control device is about 3 inches square by 1 inch thick and has 3 buttons which are used to control the tractor's movement. An order filler may control the tractor from any point within 50 feet of it, thus making it unnecessary for him to mount the tractor each time he wants to move it. Figure 3 shows an order filler operating a remote-controlled tow tractor in selecting an order.

Figure 3.--Operating a remote-controlled order-filler tractor.

As shown in table 2, with use of the remote-controlled tractor, order-filler production averaged more than 13 percent greater (182 cases per hour compared with 161 cases) than when the remote-controlled units were not used. Saving in travel time was nearly 0.06 minute at each selection point, and total travel time was reduced from 5.37 minutes to 4.26 minutes, resulting in a total saving of 1.11 minutes, or 21 percent, in the assembly of a 30-case order.

Because the remote-controlled tractor is a comparatively recent development, all of its disadvantages may not be obvious. The increased production of order fillers must be balanced with equipment cost. Durability of the equipment and maintenance cost are still to be determined.

A 4-wheel selector truck designed to reduce damage while selecting merchandise was used in one warehouse cooperating in the study. Boards about one inch thick were placed on outside edges of the 4-wheel warehouse trucks, as shown in figure 4. Figure 5 shows how the use of this board has a tendency to prevent merchandise from falling off the truck as it is towed through the warehouse and around sharp corners.

A conveyor system is an important type of materials-handling equipment used in many grocery warehouses for order selection. In modern one-floor grocery warehouses using a conveyor line for order assembly, it is usually necessary to employ power boosters at intervals to re-elevate the merchandise to provide the necessary downgrade for gravity conveyors to operate between the selection point and delivery truck. Figure 6 shows a part of the selection area in one warehouse that used a wheel-type gravity conveyor for order assembly. Merchandise was received in this warehouse and moved from the reserve storage area to the selection area by forklift trucks. The raised gate shown in figure 6 permitted the movement of forklift trucks from one warehouse area to another. (Note warehouse location numbers on pallet racks in figure 6.) Some of the advantages of a conveyor system are: (1) Reduced travel time in order assembly resulting in increased order-filler production; (2) greater use of floor space because narrower aisles can be used when merchandise receipts and shipments are made with a conveyor line; and (3) use of conveyor lines in buildings that have floors too weak for forklift operations.

A conveyor system has the following disadvantages: (1) Many items in the grocery warehouse such as sugar, brooms, and fragile case goods are not adaptable to conveyor handling and must be stored near the shipping dock for hand loading; (2) it is difficult to handle "call orders" along with the assembly of service orders, and regular hours must be established for handling this business; (3) if the same conveyor line is used for both receiving and selecting merchandise, definite hours must be established for each operation; (4) the conveyor system requires one more individual case handling than the pallet system; (5) it is more difficult to make full use of overhead space; and (6) a conveyor line has more definite limitations on the amount of merchandise that can be received and shipped on it in one day. While the business volume that can be handled on a conveyor line in a grocery warehouse can be increased by lengthening the hours of warehouse operation, it still would be less than could be handled by the pallet system.

Figure 4.--A 4-wheel selector truck with boards on outside edges to prevent merchandise from sliding off as it is towed through the warehouse.

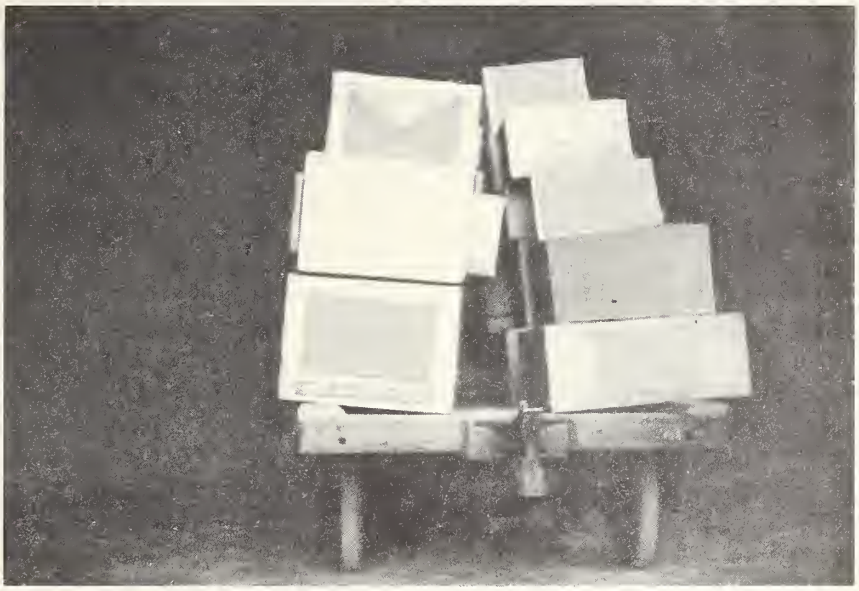

Figure 5.--A loaded warehouse selector truck showing the use of boards to reduce damage.

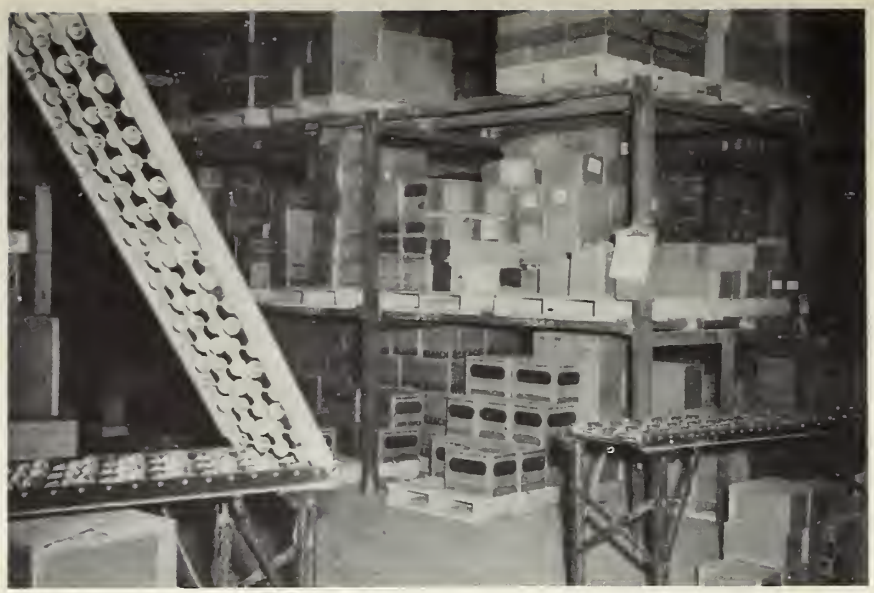

Figure 6.--A conveyor line used for selecting merchandise. The raised gate permits the entrance of a forklift truck for receiving merchandise.

Stock Arrangement for Order Assembly

The stock arrangement for order assembly follows two basic plans:

The short assembly-line system for order selection is used widely in the wholesale grocery industry. With this system, a supply of each item carried in the warehouse is arranged in an area for convenient order selection by the order filler. As the assembly line becomes depleted, it is replenished from reserve stock stored in the remaining warehouse area. The short assembly-line system has the advantage of requiring about half as much travel distance for the selection of a given order when compared with the selection of merchandise from the total warehouse area. The short assembly-line system has the disadvantage of requiring one extra handling of merchandise--moving merchandise from the reserve storage area to the selection line.

The slot system is the second basic stock plan in the modern grocery warehouse. With this system, merchandise is stored and orders are filled over the entire warehouse. Slow-moving merchandise received in small quantities is placed in a pallet rack slot and the remaining pallet loads, or reserve stock, is stored on top of the rack. Medium and fast-moving merchandise, received in larger quantities, is assigned a floor space, or slot, that will accommodate two or more pallets in depth. As the slots become empty, incoming merchandise is assigned empty slot spaces on the basis of quantity of receipts and available space, without regard to a fixed item location.

The chief advantages of the slot system over the short-selection line are: (1) One handling of the merchandise--from the reserve storage area to the assembly line--is eliminated; (2) automatic stock rotation; and (3) when stocking incoming merchandise, it is not necessary for the forklift driver to hunt for a specific location, resulting in increased productivity of forklift trucks in the receiving operation. The disadvantage of the slot system is that the distance order fillers must travel in the assembly of an order is considerably longer when compared with the short-selection line.

In a large one-floor warehouse either of the two systems of stock arrangement can be used, the most efficient one being dependent on the type and size of orders assembled and the type of warehouse materials-handling equipment used. For example, a firm servicing many orders that average 30 cases or less in size will find the short-selection line most efficient. This is especially true when order fillers assemble orders by pushing 4-wheel handtrucks, or if a tow line is used throughout the selection area. Firms servicing predominantly supermarkets or large voluntary group retailers will probably find the slot system most efficient, provided order fillers use mechanical towing equipment or a perimeter tow line to reduce travel time in filling orders.

Order Size and Productivity of Order Fillers

The productivity of order fillers increases as order size increases, largely due to an increased proportion of the time spent in selecting orders and a decreased proportion of time spent in travel. The increased productivity of order fillers with respect to order size is dependent on the warehouse layout and materials-handling equipment used. Table 3 shows the productivity of order fillers in assembling 218 orders of various sizes in 3 warehouses. Two of these firms used the slot system, with item locations numbered and with orders printed in sequence with warehouse location. In those firms using the slot system, order fillers used small gasoline and electric tractors to tow warehouse trucks for the assembly of orders. In the third firm, order selection was done with a conveyor used in combination with a short-selection line.

Of particular note in table 3 is the fact that productivity of order fillers was greater with the short-selection line and a conveyor system than with the slot system and tow tractors for the assembly of small orders. The productivity of order fillers continued to increase as order size increased. Data in table 3 are based on order-filler productive time plus a personal and fatigue time allowance of 15 percent. Avoidable delay time, such as time spent in waiting because of aisle blockage, talking, and waiting for orders, is not included in table 3.

The size of orders has an important influence on productivity of order fillers and cost of assembling orders. Figures 7 and 8 illustrate how order size affected the productivity of order fillers in the assembly of two orders in one warehouse using the slot system. Direct labor costs are based on an assumed pay rate of $1.50 per hour.

Table 3.--Productivity of order fillers in the assembly of various size orders with different assembly systems and equipment

Order size	Order-filler production			
	Slot system with tow tractors		Short-selection line conveyor system	
	Cases per hour 1/	Orders timed	Cases per hour 1/	Orders timed
Cases	Number	Number	Number	Number
1 - 9	48	14	127	20
10 - 24	82	10	134	37
25 - 49	124	10	164	29
50 - 74	141	10	175	9
75 - 99	159	6	184	6
100 -149	178	20	194	3
150 -199	192	11	-	-
200 or more	218	33	-	-
Total	-	114	-	104

1/ Includes 15 percent personal and fatigue allowance.

Effect of Delay Factors on Order-Filler Productivity

Productivity of order fillers, although largely dependent on the size of orders, materials-handling equipment used, and the overall system employed, may be affected by many other delay factors that prevent maximum productivity from being obtained. As indicated by the following examples, these factors, though often considered minor, become significant when the time lost is multiplied by the frequency of occurrences.

In one warehouse, it was found that more than 10 percent of the time of each of 9 order fillers was spent in waiting for forklift operators to let down inaccessible merchandise or to bring merchandise from the reserve storage area. Assuming the 9 men worked 8 hours per day or a total of 72 hours in filling orders each day, the 10-percent delay meant 7.2 hours per day were lost in waiting for a forklift. A small change in the system of receiving merchandise into the warehouse and assigning one forklift to the job of policing the selection area at specific times reduced the time lost to less than one hour per day. The net result of the change was increased order filler production with no increase in forklift operating cost because total forklift operating time remained unchanged.

At another warehouse, the usual practice was for order fillers to wait an average of 20 minutes each, several mornings each week, for orders to be processed in the office. Nine men waited a total of 180 man-minutes, or the equivalent of 3 hours was lost, several mornings each week, from the order-filling operation. Assuming order fillers are paid an average of

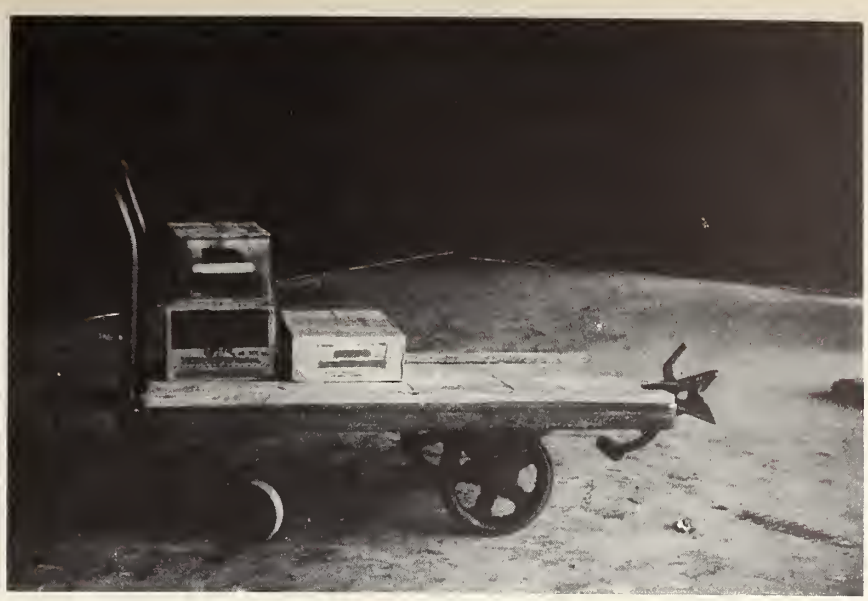

Figure 7.--An assembled 3-case order. Time required for order assembly - 4.52 minutes.
Order filler assembly rate - 40 cases per hour.
Direct labor cost to assemble the order-$0.038 per case.

Figure 8.--Part of an assembled 110-case order.
Time required for order assembly - 36.64 minutes.
Order filler assembly rate - 180 cases per hour.
Direct labor cost to assemble order - $0.008 per case.

$1.50 per hour, the firm lost $4.50 each time the delay occurred because they failed to have the hours properly coordinated for the 2 operations.

In another study, it was noted that order fillers spent more than 7 percent of their time hunting for items and frequently doubled back over routes previously traveled to pick up an item. Since the firm did not have automatic tabulating equipment, the warehouse locations were not numbered and the orders had no sequence of items. Orderly selection of merchandise was dependent upon the memory of order fillers. At this warehouse a system of arranging the sequence of items on the order with warehouse location was tested. Salesmen were given order books in which the items were listed in the same sequence as they occurred along the order fillers' travel route. By use of an improved order-taking system, similar to the one shown in figure 9, a considerable reduction in the amount of order-filler backtracking was accomplished. When orders were written in sequence with the warehouse location, order-filler production increased about 25 percent or from 57 to 71 cases per man-hour. The new system required very little capital expenditure, but did require some planning to put into operation. By adopting this practice, the firm was able to reduce the number of regular order fillers from 6 to 5.

The order form shown in figure 9 was used by salesmen in a wholesale grocery company for grouping items as they are written. This firm had automatic tabulating equipment and used salesmen to call on institutional and nonaffiliated accounts. By grouping items according to code number as sales were made, much time was saved in the tabulating room in pulling cards to be used in printing the invoice.

In one warehouse, it was found that order fillers exhausted the supply of orders several times each week, and an average of 2 hours per week was lost by each order filler in waiting for orders. Through rearranging work assignments and rescheduling retailer deliveries, total overtime paid to order fillers was reduced from an average of 60 hours a week to less than 40 hours a week.

The factors that cause order-filler production to be lower than normal are not necessarily inherent in the system as initially designed, but are frequently caused by failure to follow the system which was initially well planned. By careful observation of the order-filling operation, causes of low productivity may be noted. Order-filler delays may be caused by:

1. Time lost in hunting for a particular item.

2. Waiting for a forklift to lower merchandise from a stack or to bring merchandise from the reserve storage area.

3. Aisle blockage either by another order filler, forklift, or by merchandise.

4. Waiting for orders to be processed.

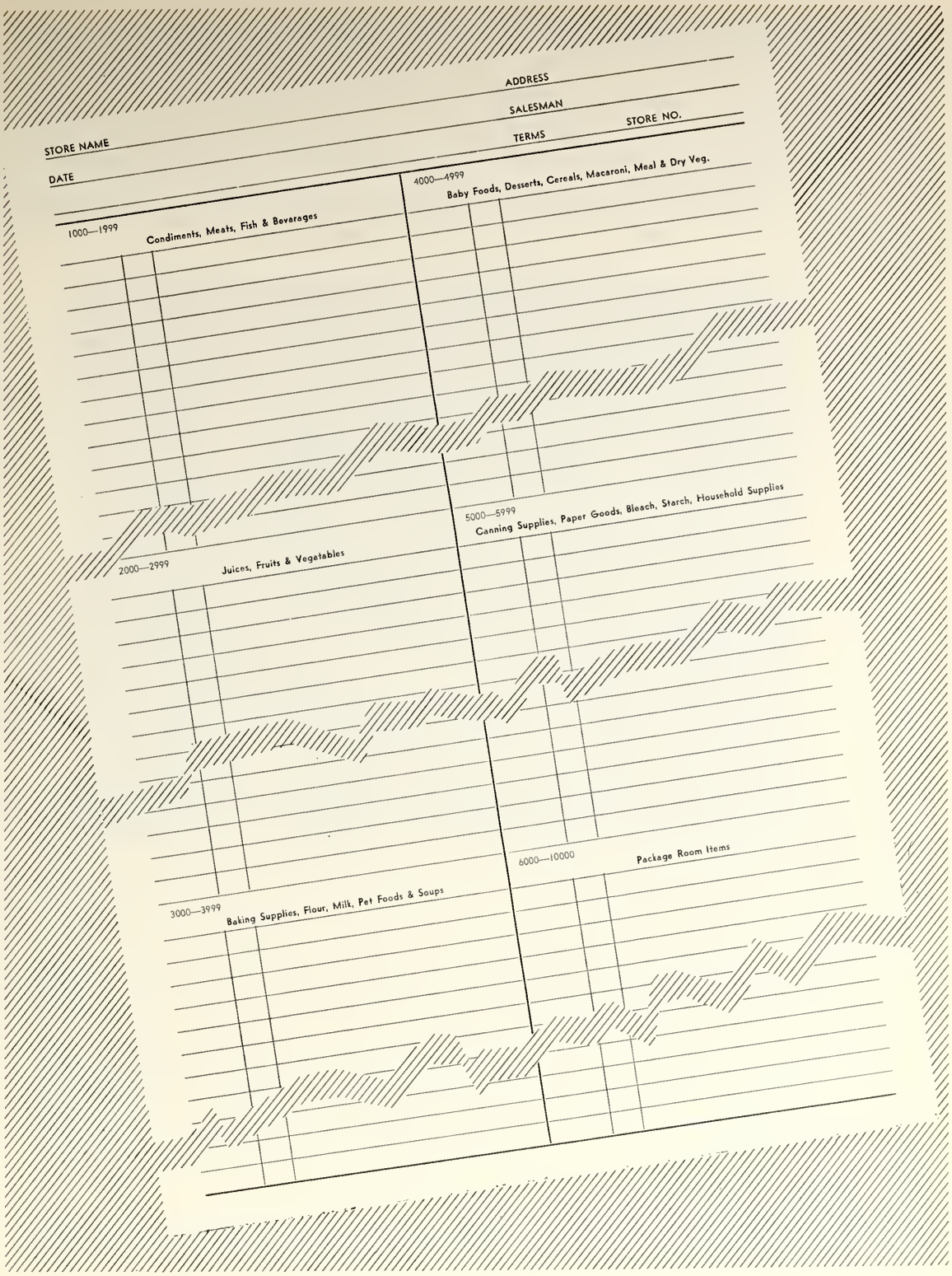

Figure 9.--An order form used by salesmen to list items in sequence with warehouse location.

5. Waiting for 4-wheel selector trucks because all trucks are loaded with assembled orders.

6. Waiting for a work assignment.

7. An excessive amount of time lost in correcting order assembly errors.

By taking into consideration all factors causing a delay, remedies may be applied to effect a saving in the overall operation.

CHECKING ASSEMBLED ORDERS

Almost 11 percent of the warehouse man-hours in the 6 firms studied were used to check assembled orders. Many grocery wholesalers feel it is necessary to make a final check for accuracy on assembled orders even though the labor cost in checking frequently seems excessive for the number of errors found. Through improved organization and work methods the number of man-hours required to check grocery orders frequently can be reduced.

Methods of Increasing Productivity of Order Checkers

During this study various methods of checking orders were studied in terms of order arrangement on selector trucks and the use of one man compared with a 2-man team. Time studies made were based on the following standard procedure for checking assembled merchandise: (1) Checking each item by description and placing a mark on the case or order sheet; and then (2) counting the number of cases in the assembled order and comparing with the number ordered.

As shown in table 4, the productivity of order checkers was increased nearly 38 percent, from 502 to 692 cases per hour, when orders were arranged on the 4-wheel truck. To arrange orders on a 4-wheel truck, order selectors placed the first half of the items on one side of the truck and the remaining half on the other side, thus eliminating the necessity of searching for each item on both sides of the selector truck as the order was being checked.

Table 4.--Comparative productivity of one man and a 2-man team in checking orders arranged and unarranged on 4-wheel selector trucks

System	Number of checkers	Standard time 1/	
		Time per case	Cases per man-hour
	Number	Man-minutes	Number
Unarranged order on 4-wheel truck.....	2	0.1194	502
Arranged order on 4-wheel truck.....	2	.0868	692
Arranged order on 4-wheel truck.....	1	.0497	1,208

1/ Includes 15 percent personal and fatigue allowance.

When one man checked orders, production per man-hour was increased nearly 75 percent, from 692 to 1,208 cases per hour, over having 2 men check as a team (table 4). When 2 men check arranged orders as a team, one man calls the item and the other marks the appropriate case. With this system, delay time occurred while one man was hunting for the item and in waiting for the other man to call the next item. By having each man work individually, these delays were eliminated, resulting in increased production. Figure 10 shows one man checking an assembled order at the shipping dock.

Figure 10.--One man checking an order arranged on a 4-wheel selector truck.

In one firm cooperating in this study the direct cost of a complete order check was reduced by 50 percent. The amount of checking to be done was more than one man could do alone, but it did not keep 2 men fully occupied. Better utilization of labor was obtained by having one man do the entire job of checking each assembled order by piece count and description and checking orders by piece count only when he got behind. 5/ After several months of performing the checking operation with one checker instead of 2, the wholesaler reported no increase in retailer complaints from receiving

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5/ For a complete description of sample checking and methods of determining whether a check is worthwhile, see Marketing Research Report No. 13, page 23. Op. cit.

incorrectly filled orders. By following this checking procedure the firm also could control order-filler errors through checking orders assembled by those order fillers prone to make errors by item description as well as case count.

One factor noted in some of the firms cooperating in the study was duplicated effort or double checking of assembled orders. For example, the order fillers checked the assembled orders by piece count and item description and the order was again checked by a regular order checker. In these instances, the double checking of all orders resulted in duplicated work.

Unit Price Marking of Cases

Some grocery wholesalers who sponsor voluntary retailer groups have been considering the marking of suggested retail selling prices on cases as an added service for their retailer customers. A study was made of price-marking merchandise at 3 different stages to determine the most efficient point to perform this operation: (1) By the order filler as he assembled the order; (2) by the order filler after assembling each order; or (3) by the checker at the shipping dock.

As shown in table 5, the productivity of order fillers in unit price marking cases was 37 percent greater when done during order assembly than after order assembly. They required 0.079 man-minute to price mark each case in addition to the regular amount of time for selecting merchandise. The time required to price mark the case by order fillers was less than by other methods tested because only one reading of the order sheet was necessary to note the item location, number of units, and suggested retail price, whereas when the cases were price marked after assembly, the order sheet had to be read again and the item found on the 4-wheel selector truck for price marking. The savings from having order fillers price-mark cases during selection totals about 0.03 minute per case or 204 cases per hour over price-marking the cases after order assembly.

Table 5.--Productivity of checkers and order fillers in price-marking retailer orders when orders are arranged and unarranged on the selector truck

Person and point of price marking	Orders arranged on 4-wheel trucks		Orders unarranged on 4-wheel trucks	
	Time per case 1/	Cases per man hour	Time per case 1/	Cases per man-hour
	Man-minutes	Cases	Man-minutes	Cases
By order filler during order assembly	0.079	756	-	-
By order filler after order assembly	.109	552	-	-
One checker at checkstand	.110	546	0.213	282
Two checkers at checkstand	.163	368	.362	156

1/ Includes 15 percent personal and fatigue allowance.

Order checkers price mark more than 200 additional cases per man-hour when orders are arranged on 4-wheel trucks than when they are unarranged, because of reduced time spent in hunting for the item to be price marked. It was also found that on a production per man-hour basis one man price marked over 125 cases per hour more than each man in a 2-man team. The study showed that after the order was assembled, the order filler and checker price mark merchandise at approximately the same rate, or 552 and 546 cases per man-hour, respectively.

LOADING DELIVERY TRUCKS

The loading of delivery trucks accounted for more than 18 percent of warehouse man-hours in the 6 firms studied. This function consisted of loading assembled orders into delivery trucks. Modern one-floor warehouses have a shipping dock wide enough to accommodate several delivery trucks, thus making it possible to load several trucks conveniently. Docks are usually built at delivery truck body level to permit easy entrance of loaded 4-wheel trucks when a small dock board is used.

Methods Used and Productivity of Truck Loaders

The predominate method used by the firms studied for loading delivery trucks was for a 2-man team to push a 4-wheel selector truck into a delivery truck for loading. Time studies were made of this operation when it was performed by one man and when performed by a 2-man team. A typical loading cycle included time to: obtain the loaded selector truck, push it inside the delivery truck and position it, load the merchandise in the truck, and push the empty selector truck out of the delivery truck. Allowance was made for time to place a bridge plate between the dock and delivery truck. As shown in table 6, one man using this method and working alone averaged 562 cases per man-hour while 2 men working as a team averaged 423 cases per man-hour. The production per man-hour with one man was 139 cases greater, almost 33 percent, than when 2 men worked as a team using the same method.

One firm cooperating in the study had delivery trucks with doors so narrow that a loaded 4-wheel selector truck could not be pushed inside. Trucks were loaded at this company by means of portable gravity conveyors, with one man placing merchandise from loaded selector trucks onto the conveyor and one man inside the truck removing merchandise from the conveyor and loading it in the truck. Production under this system was 354 cases per man-hour or 208 cases per man-hour less than when one man pushed loaded selector trucks inside the delivery trucks for loading. The lower productivity resulted from each case of merchandise having to be handled twice in the loading operation: once in placing it on the conveyor; and again in removing the merchandise from the conveyor and loading it in the truck.

Table 6 shows that productivity of truck loaders was 707 cases per man-hour when a conveyor line was run directly into the truck from the

Table 6.--Comparison of the productivity of truck loaders using various loading methods

Loading method	Number of men	Standard loading time per case 1/	Cases loaded per hour	Cases loaded per man-hour
	Number	Minutes	Number	Number
2 men--selector trucks inside delivery truck	2	0.071	846	423
1 man--selector trucks inside delivery truck	1	.107	562	562
Selector trucks onto portable conveyor at shipping dock	2	.085	707	354
Conveyor line in delivery truck (merchandise placed on conveyor by order fillers)	1	.085	707	707

1/ Includes 15 percent personal and fatigue time allowance.

selection area, where order fillers placed merchandise on the conveyor line. Productivity of loaders was 145 cases per man-hour more than when orders were unloaded from a selector truck inside the delivery truck. Increased productivity by this system resulted because it was not necessary for the truck loader to obtain the 4-wheel selector truck and push it inside the delivery truck or to remove the empty selector truck. Figure 11 shows the merging of conveyor lines near the delivery truck and the main conveyor line running directly into the truck where a man is loading merchandise. One of the greatest disadvantages in conveyor loading is that only one delivery truck can be loaded at a time.

One firm visited had built roller conveyors in the floor of their delivery trailers in an effort to reduce delivery costs. Order fillers placed a 30- by 40-inch pallet on a 4-wheel selector truck and placed merchandise on the pallet during order selection. After the merchandise was selected and checked, the pallet was lifted off the selector truck by a forklift and placed in the end of the delivery truck on the built-in rollers. After the merchandise was piled 2 pallets high at the rear of the trailer, it was pushed with the use of a small bar over the roller conveyors into the trailer and chocked into place.

At the retail store, the driver used the small bar to push pallet loads of merchandise to the tailgate and unloaded the merchandise case by case. Figure 12 shows a drawing of the conveyor installation in a trailer. The firm management believed that the operation could be further improved by the use of a hydraulic tailgate on delivery trucks. A small pallet jack could then be used to deliver many pallets of merchandise to the correct location in the back room of the retail store.

Figure 11.--Conveyor lines merge near the shipping dock and are placed directly into the delivery truck for rapid unloading.

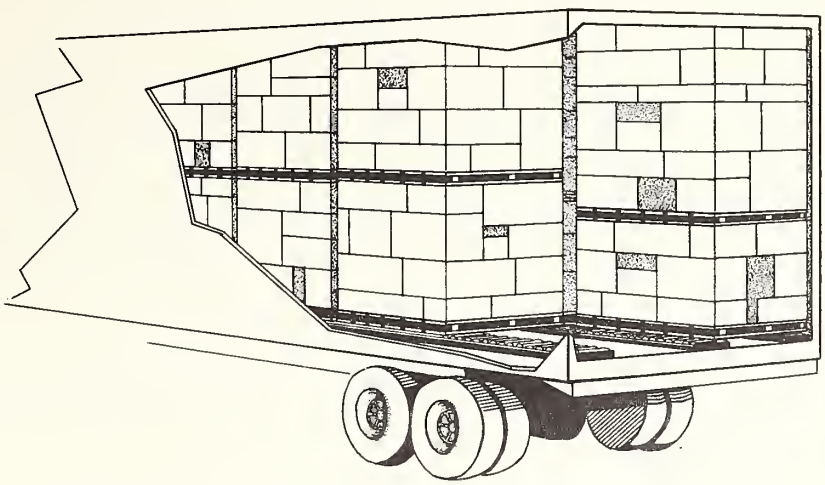

Figure 12.--Roller conveyors built in the floor of delivery trucks permit shipping orders on pallets.

The usual practice in the loading of delivery trucks is to load first the last order to be unloaded on the route. One method used for separating various orders on the delivery truck is to mark each case with the stop number; for example, 2, 3, 4, etc. Suggested economies in marking stop numbers on cases include: (1) leave the first and last stops unnumbered, provided that the merchandise for stops between the first and last are numbered; and (2) use a self-inking type band stamp to mark stop numbers on cases as the case count is made. The placing of stop numbers on cases can be done as the assembled order is being checked, as shown in figure 10.

Another recommended practice, when there are only a few large orders on the delivery truck, is to divide the merchandise for each stop with a net. Cotton cord netting of approximately 2-inch mesh is spread over the top and around the sides and botton of each order after it is loaded. The netting conforms naturally to any size or shape of container and fences off any particular lot, regardless of how the cartons may be stacked or turned. With the use of netting, it is not necessary to mark cases with stop numbers.

FACTORS IN ADDITION TO EQUIPMENT AND WORK METHODS AFFECTING PRODUCTIVITY OF WAREHOUSEMEN

Although this report has been primarily concerned with obtaining efficient warehousing operations through the use of improved equipment and work methods, such factors as retailer cooperation, employee motivation, planned warehouse organization and controls are also important. The relative importance of each of the factors cannot be easily measured, since an efficient grocery warehouse operation is dependent on a balance of inter-related factors discussed in this section, as well as work methods and equipment.

Retailer Cooperation

Wholesale grocers have an excellent opportunity for increasing warehousing efficiency through retailer cooperation. 6/ A retailer can be shown how adopting such practices as increasing his order size by concentrating his purchases with one wholesaler and having his orders in on time can contribute to a more efficient and a lower cost warehousing operation. Table 3 on page 14 shows how order size affects the productivity and efficiency of order selectors. Economies obtained through larger store orders are also reflected in a more economical delivery operation.

The acceptance by affiliated retailers of orders on the basis of a case count rather than the traditional check by item description and case

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6/ For a complete discussion on areas of wholesaler-retailer cooperation see: Bouma, John C.,and Kriesberg, Martin. Views of Independent Grocers on Wholesaler-Retailer Relations. MRR No. 42, PMA, U. S. Dept. Agri. 1953.

count has resulted in a considerable time saving at each delivery stop. If the retailer finds an error after accepting an order on the basis of a case count, an adjustment can be made by returning the case received in error in exchange for the proper case. Some wholesalers have obtained retailer assistance in unloading delivery trucks which has resulted in: (1) Reduction of time spent at each stop; (2) more orders being delivered each day; (3) reduction of overtime paid to truck drivers; and (4) one driver on delivery trucks instead of a driver and a helper.

In servicing an affiliated group of retailers, the wholesaler has a greater opportunity to achieve an improved workload balance than one not servicing such a group. With the assistance of the retailer, the warehouse and delivery workload can be planned with certain accounts scheduled for service each day. Through a scheduled service arrangement, retailer cooperation can do much to eliminate excessive overtime and heavy workloads on Tuesday, Wednesday, and Thursday of each week and the light workloads on Monday and Friday.

Employee Motivation

During this study, it was found that there was a considerable range in employee performance (productivity) among employees with apparently the same ability and using the same work methods. This was frequently attributable to differences in employee motivation. Some firms have provided employee benefits, recognized individual employees, and impressed each employee with the importance of his job in an attempt to increase employee loyalty, job stability, and motivation.

An example of employee motivation is the use of safe-driving awards for delivery-truck drivers. Many firms have reported a substantial reduction in accident rates when individual drivers were recognized with citations and given cash awards for safe driving.

Another method used by some firms to improve the efficiency of employees is regularly scheduled meetings with such employee groups as drivers or warehousemen, at which employee participation in discussions on company problems is encouraged. Meetings of this type provide an excellent opportunity to "sell" the company to employees, to give them the feeling of being in the "know" on company problems and policies and to obtain many worthwhile ideas.

Some firms are reducing employee turnover by providing, in addition to regular salary, such extra benefits as life insurance policies paid for by the company, full pay during periods of illness, annual employee outings, bonuses at the end of the year, and employee profit-sharing plans.

Firms report obtaining efficiencies in the performance of a particular job through employee suggestion systems. The purposes of such a system are: (1) To encourage employee thinking toward the development of cost-saving ideas; (2) to get good ideas into practice; and (3) to improve

employee morale. Rewards for acceptable suggestions are usually cash, together with recognition for effort by the individual employee. Each employee making a suggestion is notified of actions taken with respect to his proposal.

Warehouse Cost-Control Programs

Because warehousing is such an important part of the wholesaler's operating costs, a system of measuring and controlling warehousing costs is necessary. Since labor accounts for more than 50 percent of these costs, most warehouse cost-control programs are primarily designed to measure operating efficiency and cost of labor. Three measures of efficiency used by cooperating firms in this research project included: (1) Tons per man-hour; (2) cases per man-hour; and (3) dollar volume handled per man-hour.

Tons per man-hour is probably the most effective and widely used measure of efficiency for the overall warehouse operation. To compute the overall tons per man-hour, the total weight of receipts plus the tons of merchandise shipped out of the warehouse during a given period, are divided by the total direct labor hours. Direct labor includes the hours spent in receiving, storing, selecting, transporting, checking, and loading. Time spent for supervision and maintenance, as well as janitor and clerical time, is usually excluded.

Some firms compute tons per man-hour on such segments of the overall warehouse operation as rail-car unloading, selecting, checking, and loading, whereas other firms measure the productivity of warehousemen in the different classes of work and in terms of cases or pieces handled per man-hour. The usual practice is to keep the productivity records of individual order selectors and checkers in terms of cases per man-hour in conjunction with records of tons per man-hour on the other segments and the overall warehouse operation.

An additional measure of the productivity of warehousemen is in terms of dollar value of merchandise handled per man-hour. It is frequently used by firms that do not have automatic tabulating equipment. A combination record of tons per man-hour and cases per man-hour is favored over dollar value of merchandise handled data because: (1) The measuring units (weight and cases) remain constant while dollar values change; and (2) a large segment of the industry does maintain records on the basis of tons and cases per man-hour.

In the establishment of a warehouse cost-control program, the sequence of action follows 3 steps:

First, data must be obtained on the specific items that are to be measured. Data for the establishment of tons per man-hour reports require the tabulation of weight of warehouse receipts from bills of lading, the tabulation of the weight of warehouse shipments from shipping invoices, and a record of direct labor hours in the warehouse. Cases per man-hour

are easily tabulated for individual order fillers and checkers by keeping a tabulation of cases assembled or checked and dividing the resulting figure by the number of hours each man is employed on the job.

The establishment of comparative tons per man-hour and cases per man-hour data in those firms not having tabulating equipment is more difficult. In order to obtain an estimate of the overall tons per man-hour, it is necessary to: (1) Divide the total cost value of merchandise received into the warehouse and shipped out of the warehouse by the average value of a ton of groceries; and (2) divide the resultant figure by the direct warehouse labor hours. This would give an approximate tons per man-hour record.

After data have been collected and summarized on items to be measured, it must be compared with a standard. The standard used by most grocery wholesalers is usually established on the basis of past performance. A record of past performance often gives a better basis for the establishment of realistic production goals than comparisons with production in other firms because conditions vary so widely with respect to warehouse type, work methods, equipment, layout, order size, and services performed. Some national trade organizations have established comparable tons per man-hour data for cooperating members to give each member firm an idea of how its warehousing system compares with the production of other firms in the industry.

The third step consists of an action program for improving the level of performance. Cost control data give only an indication of what is happening; for example, the warehouse tons per man-hour may be half of a ton below last month's figure. An inspection of the warehouse may reveal the warehouse is overcrowded, with much aisle blockage; a significant change may have taken place in the labor force; or some other such factor has impaired the operating system. The action program and the results achieved will depend largely upon management's ability to analyze the situation found through the cost-control program.

In addition to labor cost, there are other warehousing cost elements, such as insurance, taxes, heat, light, water, rent, depreciation on warehouse equipment, and supervision, that can have a measure of control applied to them by keeping comparative records for a period of time.

In addition to cost controls there may be other controls that should be inaugurated by grocery warehouse management. Some controls applicable to grocery warehousing that are widely used in industrial plants include:

1. The number of customer complaints for a certain period of time or for a certain sales volume.

2. A measure of the accident frequency rate, which is the number of disabling injuries per one million man-hours worked, and, on which compensation insurance rates are usually based.

3. Accident severity rate, which is the number of days lost through disabling injuries per 1,000 man-hours worked.

4. Absenteeism, a measure of the days absent for any given period.

5. Labor turnover, which would probably include the ratio of separations to the average working force for a period, usually a month or a year.

6. Warehouse damage, including the cost of breakage per 1,000 man-hours worked in the warehouse.

7. Inventory turnover, which is the sales for a given period divided by the average inventory for that period.

Planning for the Installation of New Work Methods and Equipment

In planning a change in the method of warehousing, management should know before making the change what saving the new system will accomplish and how long it will take before the capital expenditures for new equipment will be returned through labor savings and increased business volume. The same need for planning exists when plans are drawn up for a new warehouse. All anticipated increases in occupancy costs in a new warehouse should be covered by realistically projected labor savings and increased business volume. The method of continuing business while the move takes place should also be planned in detail in order to accomplish the least possible business disruption.

In order to obtain complete adoption of improved methods, equipment, and policies, meetings might be held with employees affected by the improved methods or equipment to insure complete understanding and adoption. At such a meeting the improved methods or equipment could be fully explained, together with an explanation of expectations from the use of the system or equipment. The employees should be given an opportunity to ask questions and to participate in demonstrations of how the improved system or equipment is expected to work.

The use of improved work methods and equipment is sometimes limited by existing warehouse structures. Additional research would be required for an adequate appraisal of alternative methods and equipment for use in existing multistory and small one-story warehouses.

RESULTS OF APPLYING IMPROVED METHODS AND EQUIPMENT IN 6 GROCERY WAREHOUSES

An average saving of 13 percent in warehouse man-hours was accomplished during this study as findings were applied in the 6 warehouses. An average projected saving of an additional 8 percent can be expected, for a total saving of 21 percent, after new equipment is installed and in operation (table 7).

Table 7.--A comparison of the number of weekly warehouse man-hours required, using former methods, with the number of man-hours using improved methods in the receiving, order assembly, checking, and loading operations in 6 grocery warehouses

Method 1/	Weekly man-hours required in grocery operations						
	Receiving	Order assembly	Checking	Loading	Total 4 operations	Savings	
						Man-hours	Percent
	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours	Man-hours	Percent
Company A							
Former	423	423	165	376	1,387		
Improved	376	329	90	282	1,077	310	22
Projected	306	329	90	282	1,007	380	27
Company B							
Former	288	240	96	192	816		
Improved	288	192	96	144	720	96	12
Projected	240	192	96	96	624	192	23
Company C							
Former	405	450	135	270	1,260		
Improved	405	450	135	180	1,170	90	7
Projected	405	405	135	180	1,125	135	11
Company D							
Former	176	176	88	88	528		
Improved	132	176	44	88	440	88	17
Projected	132	150	44	88	414	114	22
Company E							
Former	176	440	88	88	792		
Improved	132	352	44	88	616	176	22
Projected	132	264	44	88	528	264	33
Company F							
Former	240	528	144	144	1,056		
Improved	240	528	144	144	1,056	-	-
Projected	240	384	144	144	912	144	14
Total all companies:							
Former	1,708	2,257	716	1,158	5,839		
Improved	1,573	2,027	553	926	5,079	760	13
Projected	1,455	1,724	553	878	4,610	1,229	21

1/ The former method shows the number of man-hours required before improvements resulting from the study were made. The improved method shows number of man-hours required when improved work methods and equipment were adopted. The projected method shows the estimated number of man-hours required when new equipment is installed and in operation.

The receiving operation formerly used, required a weekly total of 1,708 warehouse man-hours in the 6 firms. This number was reduced to 1,573, a weekly saving of 135 man-hours, through use of improved work methods. In firms D and E, a saving of 88 man-hours, equivalent to 2 men, was accomplished by separating the forklift storing operation from the palletizing operation. In firm A, a weekly saving of 47 man-hours resulted from less forklift delays. A projected saving of an additional 70 man-hours in firm A and 48 man-hours in firm B is based on the use of one man rather than a 2-man team for unloading cars. New pallet jacks are required and the saving may be realized as soon as they are obtained.

In the test firms, a total of 2,257 man-hours was required weekly for the former order assembly operation. The number of man-hours was reduced to 2,027, or 10 percent, through improved work practice and organization. In firms A and B the time required for order assembly was reduced by 142 man-hours, or 21 percent, through a reduction of order-filler delays in waiting for inaccessible merchandise to be lowered or brought from reserve storage and in waiting for orders and selector trucks. In firm E, a weekly saving of 88 man-hours, or 20 percent, was accomplished by reducing order-filler delays in waiting for orders and selector trucks and by listing the items on invoices in the sequence of their warehouse location. Projected weekly savings of 189 man-hours were estimated for firms C and F with the use of mechanical tow tractors by order fillers. For firms D and E, an estimated additional saving of 114 man-hours weekly in the order assembly operation will occur when warehouse locations are numbered and automatic tabulating equipment is used for printing warehouse location numbers on the invoice.

In the 6 firms, the total weekly man-hours employed in the former checking operation was reduced nearly 23 percent, from 716 to 553, by the adoption of improved practices. In firm A, a weekly saving of 75 man-hours was accomplished through use of sample checking. In firms D and E, a weekly saving of 88 man-hours was accomplished in the checking operation by having a single checker replace 2-man teams.

The number of man-hours in the conventional loading operation was reduced 20 percent, from 1,158 to 926, by the adoption of improved practices. The 232 man-hour saving was accomplished in firms A, B, and C through having one man load delivery trucks rather than a 2-man team. A projected weekly saving of 48 additional man-hours will be accomplished in firm B when new delivery trucks are purchased with doors that will permit the entry of selector trucks for loading. Present delivery trucks are loaded by means of a portable gravity conveyor because truck doors are so narrow that a loaded selector truck cannot be pushed inside.

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